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Application No.: 10/603,655	) Examiner: Unassigned
Filed: June 26, 2003	) Confirmation No.: 4045
For: A MOBILE BUILDING UNIT AS WELL AS A BUILDING AND A METHOD FOR CONSTRUCTING THE BUILDING	)

CLAIM FOR CONVENTION PRIORITY

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The benefit of the filing date of the following prior foreign Patent Application in the following foreign country is hereby requested, and the right of priority provided in 35 U.S.C. § 119 is hereby claimed:

Swedish Patent Application No. 0202031-1

Filed: July 1, 2002

In support of this claim, enclosed is a certified copy of said prior foreign Patent Application. Said prior foreign Patent Application is referred to in the oath or declaration. Acknowledgment of receipt of the certified copy is requested.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

Date: September 15, 2003

By: Benton S. Duffett Jr.

Benton S. Duffett, Jr.
Registration No. 22,030

P.O. Box 1404
Alexandria, Virginia 22313-1404
(703) 836-6620

(05/03)

PRV
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Härmed intygas att bifogade kopior överensstämmer med de handlingar som ursprungligen ingivits till Patent- och registreringsverket i nedannämnda ansökan.

This is to certify that the annexed is a true copy of the documents as originally filed with the Patent- and Registration Office in connection with the following patent application.

(71) Sökande Applicant (s) — *Elekta AB, Stockholm SE*

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För Patent- och registreringsverket
For the Patent- and Registration Office

Kerstin Gerdén

Kerstin Gerdén

Avgift
Fee 170:-

PATENT- OCH REGISTRERINGSVERKET SWEDEN
Postadress/Adress: Box 5055, S-102 42 STOCKHOLM
Telefon/Phone: +46 8 782 25 00, Vx 08-782 25 00
Telex: 17978 PATOREG S
Telefax: +46 8 666 02 86, 08-666 02 86

AWAPATENT AB
Kontor/Handläggare
Söderhamn/Bengt Forslin/BF

ELEKTA AB
Ansökningsnr

Vår referens
SE-2028227

RADIATION SHIELDING PARTITION UNIT, ROOM AND BUILDING AS WELL AS A METHOD FOR CONSTRUCTING THE SAME

Field of the invention

The present invention relates to a room enclosed by wall, roof and floor portions for accommodating radiating equipment and for treatment, therapy or diagnosing by means of ionizing radiation, wherein at least one of the wall, the roof or the floor of said room serve as a radiation shielding barrier for preventing radiation at health-impairing levels from escaping to the outside of the room.

The invention also relates to partition units used to construct such a room and to a building containing such a room.

The invention also relates to a method for constructing a building including such a room.

Background of the invention

Installation of radiating equipment, such as equipment for X-ray imaging, radiation surgery or therapy, or radiation sterilization of various products such as e.g. foods or material, is elaborate and time-consuming since the radiation generating equipment must be enclosed by a radiation shielding so that only the patient or the product being treated, is exposed to the high radiation levels necessary. The radiation shielding is normally accomplished by constructing the walls, roof and floor of the room, where the equipment is located, of very thick concrete, often in the order of about 500 mm or thicker. For an existing building this necessitates an extensive reconstruction. Additionally, since the equipment often is very heavy, e.g. equipment for radiation surgery weighs about 20 tons, it may require reinforcement of the floor structure.

An alternative method is to cover the walls, roof and floor with plates of a material with high density, e.g. lead. However, this will be more costly than by using concrete and at least equally heavy.

Consequently, the radiation equipment normally is accommodated in a separate building, either as a completely freestanding building or connected to another building, such as a main building of a hospital. However, constructing a completely new building of concrete is elaborate and time-consuming and involves planning, foundation work, concrete casting of the building structure, installation of water pipe system, electrical system, communication system, temperature control system and ventilating system, inner and outer covering of the walls, roof and floor including insulation if any, as well as installation of the radiation equipment in the completed building. Altogether this is a process which often is extended over a period of six months or more.

Consequently, there is a long implementation time from the decision to acquire new equipment to being able to put it into operation. This is of course a big disadvantage since the radiation equipment and the specially designed building, ties up a large amount of capital and it is naturally desirable to have a rapid yield on invested capital. From the buyers point of view it is therefore of great advantage if the equipment can be put into operation as soon as possible to gain benefit of the investment.

Another disadvantage with such a specially constructed radiation shielded building is that it is not a flexible solution which can easily be re-allocated to another location, altered in its size or used for another purpose. On the contrary it is very difficult, or even impossible, to move a building of that size with such thick concrete walls and roof, and it is also difficult to rebuild or expand the building, e.g. for another application or just to expand the space for the same or

similar activity, if that is desirable. The only remaining alternative in practice when it is desirable to change the function or location, is therefore often to demolish the building.

Summary of the invention

One object of the invention is to provide an improved radiation shielded partition unit, room and building which easily and quickly can be constructed to enable shortening of the time from decision to invest to putting the equipment into operation. It is also an object to provide a radiation shielded room and building which is flexible and which easily can be transferred to another location or by which the size easily can be altered. At least these objects can be achieved with a partition unit according to claim 1, a room according to claim 6 and to a building according to claim 15.

The invention also refers to a method for constructing such a room and/or building with essentially the same objects as above. These objects are achieved with a method according to claim 24.

Accordingly, the invention is based on the understanding that the above-mentioned objects can be achieved by constructing the room and/or building in one or more units, wherein at least one of the walls, floor and roof are designed with an outer and an inner partition element with a space or an accommodation between the partition elements.

In accordance with the invention, partition units are provided that can be used to construct one or more walls, the roof and/or the floor of a radiation shielded room. These partition units have inner and outer partition or wall elements and a space between the partition elements, or may be formed as a cavity, or may be any other configuration which allows a material capable of providing radiation shielding to be inserted

or added to the partition unit once it has been assembled into the room or building.

Because the fillable radiation shielding material can be added after the partition units are already in place at the site, the units are easily transportable. Therefore, the units can be manufactured at an industry plant or construction site, remote from the final location or operating site of the building, and thereafter transferred to the operating site and assembled there. The partition units may be transferred to the operating site as separate partition units, e.g. wall, roof or floor units, which are assembled to a room or a building at the operating site or installed as barrier elements in an existing building. The partition units may also be assembled into building units, including e.g. one or more walls, roof and floor, at the constructing site and transferred in an assembled state to the operating site. During the manufacture of the units, the foundation work at the operating site may be prepared so that when both the foundation work and the units are completed, the units are transferred to the operating site and assembled.

When the assembling is finished, the spaces between the inner and outer partition elements may be filled with any fillable material capable of providing radiation shielding when contained within the partition unit. Suitable fillmaterial include a liquid, e.g. water, or a particulate or grain shaped solid bulk material, e.g. sand.

By letting the fillable material form an essential or a main part of the radiation shielding barrier between the radiation equipment and the environment, the units will have a comparatively low weight in a state where the spaces in the walls, roof and/or floor are unfilled. This enables transport of the units by truck, train or boat from the construction site to the operating site. Not until the units are installed and assembled at the

operating site, the radiation shielding is arranged by filling the fillable material in the spaces in the partition units.

This also enables removal or re-allocation of the building, if so desired, by easily emptying the fillable material and thereafter loading the building units on a carriage.

The radiation shielded building may be formed in one single unit but generally, the required size will make it advantageous to assemble the building by connecting two or more mating units to each other. In a hereafter shown and described preferred embodiment of the invention, the radiation shielded building is composed of two mating, "container-like" building units forming a radiation shielded treatment room for treatment of a patient. The building also comprises an operator room accommodated in a third building unit, but that third building unit need not be radiation shielded since no radiation is generated in the operator room. However, the wall between the operator room and the treatment room must of course be radiation shielded. In the preferred embodiment this has not been accomplished by a fillable material in a space in the wall, but through a sandwich wall structure with absorbing metal plates, e.g. steel plates.

The width of the space in the walls, roof and/or floor is dependent on for instance the type of radiation, the radiation intensity and the type of material used as a fillable material. In the exemplified embodiment, water is used as a fillable material in a building adapted for radiation surgery with gamma-radiation and in that case a space of between 500 to 1500 mm is generally sufficient.

When using water as a fillable material, the spaces in the walls, roof and/or floor of the building preferably are formed as closed spaces or "tanks" to prevent leakage or evaporation of the water. In the preferred embodiment a thin layer of insulation is arranged on the inside as well as the outside of the

walls and roof. To ensure a comfortably indoor climate and to prevent freezing of the water to ice during winter, the water in the spaces may be connected to a temperature controlling system for warming the water during the cold season and possibly cooling the water during the warm season.

The water in the partition spaces may also be automatically monitored, by a water levelling system, to eliminate the risk of unintentional lowering of the water level due to leakage or the like, and resulting deteriorated radiation shielding protection.

In the preferred embodiment the partition elements in the walls and roof are made of sheets of steel applied on a system of steel beams. To prevent corrosion an additive preferably is added to the water. However, it would be possible to make the partition elements of other materials, such as for example concrete, possible in combination with plastic film to ensure impermeability to water.

In the preferred embodiment, three of four walls and the roof include waterfilled spaces. The wall between the treatment room and the operator room does however not include a waterfilled space, since the radiation from the radiation surgery equipment, for which the building is adapted, is low in the area behind the equipment and therefore the necessary radiation shielding can be achieved by a comparatively thin layer of steel sheets. Neither the floor is provided with a waterfilled space since the building is adapted to be placed on a foundation in form of a concrete slab which will provide for the necessary radiation shielding. It is to be understood, however, that a building according to the invention may be constructed with spaces filled with various materials in all of the boundary elements defining the building. It would also be possible to have only some of the walls provided with material-filled

spaces, whereas the roof are in the form of e.g. a solid concrete plate which is placed on top of the walls.

When using a pulverous or granular material, such as sand, instead of a liquid, as a radiation shielding material, the walls, roof and/or floor of the building may have another design. Among other things the spaces need not be hermetical closed to prevent evaporation. Generally, the inlet as well as the outlet openings need to be of a larger dimension since a pulverous or granular material, as a rule, are not possible to be pumped, but must be poured or blown into and out from the spaces. The outlet openings may, for instance, be in form of lids in the bottom portions of the walls to allow emptying.

However, as a rule it is more advantageous to use a liquid as a fillable material since then it is easier to monitor unintentionally lowering of the filling ratio of the material, and to prevent unintentionally formation of air pockets, with deteriorated shielding capacity as a result. Naturally, water is preferred as a fillable material as it is a low cost material which is easily accessible in most places.

When assembling the building of two or more building units, it is important that all connection joints between different units will be performed in a sealed manner to prevent radiation from escaping to the environment. This is suitably ensured by forming all connection joints in a labyrinth form.

With a building according to the invention, it is possible to start the construction of the building structure essentially simultaneously with the foundation work. The building structure is preferably constructed at an industry plant and in the preferred embodiment the building is assembled by three different units. Two units forming the radiation shielded treatment room and one building forming a non-shielded operator room. Though preferred, but not necessary, all units are assembled at the industry and are provided with electrical system,

communication system, temperature control system, ventilating system, as well as inner and outer covering of the walls, roof and floor including insulation if any. However, as an alternative, some of the installation may be performed at the operating site if that is desired. That is the case for instance with the installation of the radiation equipment, which often is both heavy and sensitive, and will normally be postponed until the building is situated at the operating site. The same applies normally for computers and other sensitive equipment. Of course such sensitive equipment may also be preinstalled if care is taken during transportation and handling.

In the preferred embodiment the building thereafter is disassembled at the constructing site, into the three separate units and transported to the operating site where they are assembled on the foundation. Finally the radiation equipment, computers and the like, are installed after which the building and the equipment is ready to be taken into operation.

In the following detailed description of a preferred embodiment of the invention, a radiation shielded building adapted for use in radiation surgery of human beings is described. However, it is to be understood that the building according to the invention is applicable for any kind of radiation equipment, e.g. equipment for treatment of animals or foods or any other type of living organism or nonliving material.

<u>Brief description of the drawings</u>

The invention will now be explained by way of example with reference to the accompanying drawings, in which:

Fig 1 is a perspective view of a building adapted for radiation treatment, including a building unit according to the invention,

Fig 2 is a cross sectional plan view from above of the building in fig 1, and

Fig 3 is a cross sectional side view along the line III-III in fig 2.

Detailed description of a preferred embodiment of the invention

In the drawings is shown a preferred embodiment of a building, according to the invention, adapted especially for radiation surgery treatment of human beings. The building is assembled of three separate building units 1, 1', 2, of which only the outer contour of the building unit 1' is shown in fig 1. A treatment room 3 is jointly formed by the building units 1, 1' and an operator room 4 is formed by the building unit 2.

The building units 1, 1', 2 has each, in the preferred embodiment, a length in the order of about 6-9 m, a width of about 3-4 m and a height of about 4-5 m. Dimensions that makes them well suited for transportation on roads or railways as well as by sea.

As evident by the drawings, the building units 1, 1' are essentially identical but reversed and include wall portions on three of their four sides, a floor and a roof portion. The fourth side of each of the building units is open in order to mutually define a comparatively large treatment room 3 when placed adjacent each other. A radiation generating unit 5 for radiation surgery is placed in the treatment room 3 as shown in fig 2 and 3. Accordingly, the treatment room 3 has to be provided with a radiation shielding to prevent radiation from escaping from the treatment room to the environment and to the operator room 4.

The radiation shielding for three of the wall portions 6, which are faced toward the outside, and for the roof portion 7 of the treatment room, is accomplished by each having a double walled structure with an inner partition element 8, an outer partition element 9 and a

space 10 forming a closed tank between the inner and outer partition elements 8,9. The partition elements are formed of steel plates or sheets on a system of steel beams, with a space of about 800 to 1400 mm between the plates. The tank 10 may be unitary and common for a whole building unit 1, 1', but it may also be subdivided into smaller tanks. However, the tanks are separate for each of the building units 1, 1'. Each tank forms a closed, liquid tight container for water which is fillable through not shown inlet openings.

The radiation shielding in the intermediate wall 11 between the treatment room 3 and the operator room 4, on the other hand, is provided by a sandwich wall structure including steel plates on a system of steel beams. Between the treatment room 3 and the operator room 4 is also a door 12 which is made of lead to give sufficient radiation shielding.

The floor portion 13 of the building unit 1, 1' is in form of a steel plate and does not in itself have sufficient radiation shielding capacity. However, the floor portion 13 is adapted to interact with a not shown foundation to give the required radiation shielding.

The wall and roof portions 6, 7 of the building units include inner and outer insulation layers as well as inner and outer covering layers. The building unit 2 also include a recess or accommodation 16 adapted for installation of e.g. ventilation and temperature controlling equipment.

CLAIMS

1. A partition unit for shielding against radiation comprising inner and outer partition elements (8, 9) having a space (10) therebetween, said space being capable of being filled with a material that with the inner and outer partition elements provides a shield against health-impairing levels of radiation.

2. A partition unit according to claim 1, wherein the space (10) forms a closed, liquid impermeabel tank.

3. A partition unit according to claim 2, wherein the tank contains water.

4. A partition unit according to claim 3, wherein it comprises a system for monitoring the water level.

5. A partition unit according to claim 1, wherein the space (10) contains sand.

6. A radiation shielding room in which at least one of the walls, the roof or the floor comprises a partition for preventing radiation at health-impairing levels from escaping to the outside of the room, said partition being provided with an interior space (10) for receiving a material which with the partition walls provides a barrier preventing passage of health-impairing levels of radiation.

7. A radiation shielding room according to claim 6, wherein it is assembled of two or more partition units.

8. A radiation shielding room according to claim 6, wherein the interior space (10) forms a closed, liquid impermeable tank.

9. A radiation shielding room according to claim 8, wherein there are two or more separat tanks (10) enclosing the room.

10. A radiation shielding room according to claim 8, wherein the tanks (10) contains water.

11. A radiation shielding room according to claim 10, wherein it comprises a system for monitoring the water level.

12. A radiation shielding room according to claim 10, wherein it comprises a system for temperature control of the water.

13. A radiation shielding room according to claim 6, wherein the spaces (10) contains sand.

14. A radiation shielding room according to claim 6, wherein it is adapted for treatment of humans.

15. A building including at least one room (3) enclosed by wall (6), roof (7) and floor (12) portions for accommodating radiating equipment (5) for treatment, therapy or diagnosing by means of ionizing radiation, wherein at least one of the walls, the roof or the floor of said building (1, 1') serve as a radiation shielding barrier for preventing radiation at health-impairing levels from escaping to the outside of the building structure, wherein at least one of the walls, the roof or the floor comprises a double walled structure comprising an inner (8) and an outer (9) partition element with a space (10) therebetween, and a filling inlet through which the space is fillable with a fillable material, in order to reduce weight and facilitate transportation of the assembled building with the space in an emptied state, and to allow filling of the space with the

fillable material once the building is located at a site, where it is to be used, to provide a radiation shielding barrier with a sufficient shielding capacity.

16. A building according to claim 15, wherein it is assembled of two or more building units (1, 1').

17. A building according to claim 15, wherein the space (10) forms a closed, liquid impermeable tank.

18. A building according to claim 17, wherein there are two or more separate tanks (10) in the building.

19. A building according to claim 17, wherein the tanks (10) contains water.

20. A building according to claim 17, wherein it comprises a system for monitoring the water level.

21. A building according to claim 17, wherein it comprises a system for temperature control of the water.

22. A building according to claim 15, wherein the spaces (10) contains sand.

23. A building according to claim 15, wherein it is adapted for treatment of humans.

24. In a method for constructing a room for radiation delivery equipment, the improvement comprising constructing one or more walls, the roof and/or the floor by forming a partition having an inner and an outer partition element (8, 9) and a space (10) bounded by the partition elements, placing said partition in the desired location for the wall, roof or floor and filling the space with sufficient radiation shielding material to provide a radiation shield.

25. A method according to claim 24 for constructing a building of the type including at least one room (3), enclosed by wall (6), roof (7) and floor (12) portions, adapted for accommodating radiating equipment (5) for treatment, therapy or diagnosing by means of ionising radiation, including to construct at least one of the walls, the roof or the floor of said building as a radiation shielding barrier for preventing radiation at health-impairing levels from escaping to the outside of the building structure during operation of the radiating equipment, including the steps to construct at least one of the walls, the roof or the floor as a double walled structure comprising an inner (8) and an outer (9) partition element with a space (10) therebetween, and to fill the space with a fillable material to provide a radiation shielding barrier with a sufficient shielding capacity.

26. A method according to claim 25, including the further steps to manufacture the building (1, 1') at a constructing site, to transport the building to an operating site, and not until then to fill the spaces (10) with the fillable material.

27. A method according to claim 24, including the further step to fill the spaces (10) with water.

28. A method according to claim 24, including the further step to fill the spaces (10) with sand.

29. A method according to claim 24, including the further step to use the building for treatment of humans.

Abstract

The invention relates to a building including at least one room (3) enclosed by wall (6), roof (7) and floor (12) portions for accommodating radiating equipment (5) and for treatment, therapy or diagnosing by means of ionizing radiation. At least one of the walls, the roof or floor of said building (1, 1') serve as a radiation shielding barrier for preventing radiation at health-impairing levels from escaping to the outside of the building structure. At least 0one of the wall, the roof or floor of the building has the form of a double walled structure comprising an inner (8) and an outer (9) partition element with a space (10) therebetween. The building also has a filling inlet through which the space is fillable with a fillable material, in order to reduce weight and facilitate transportation of the assembled building with the space in an emptied state, and to allow filling of the space with the fillable material once the building is located at a site, where it is to be used, to provide a radiation shielding barrier with a sufficient shielding capacity. The invention also relates to a radiation shielding partition unit, a room and a method for constructing the same.

Selected for publication: Fig 2

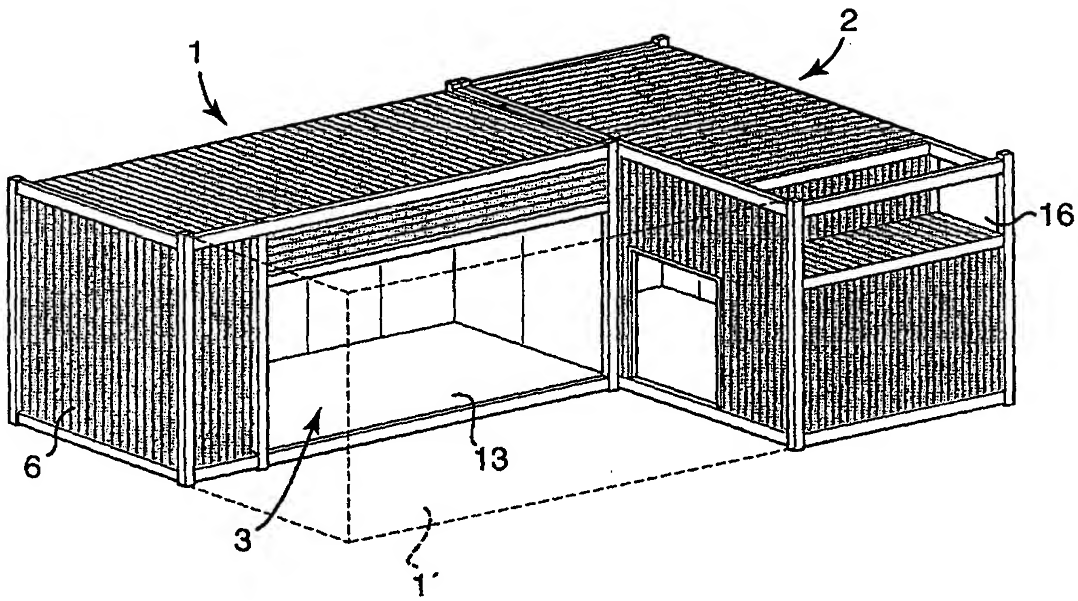

Fig 1

Fig 2

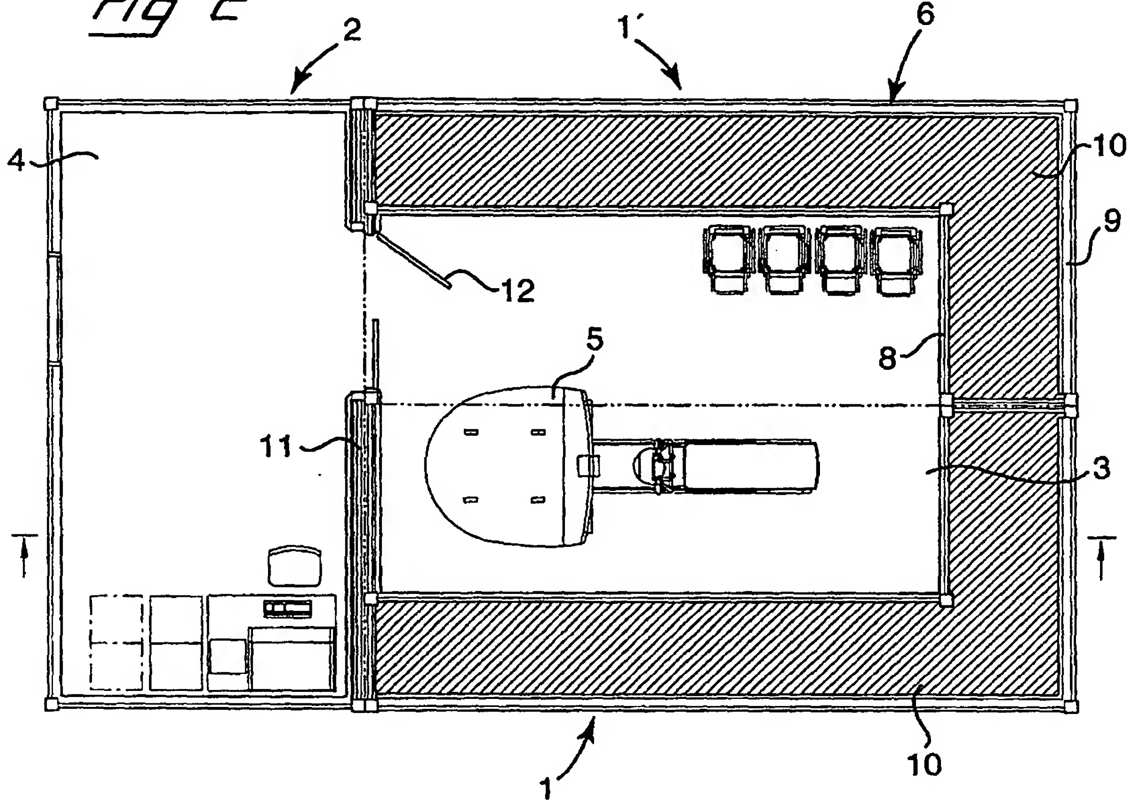

Fig 3